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STUDIES AND PROPOSALS ON REMOTE SENSING PROGRAMS FOR THE EVALUATION AND MANAGEMENT OF RESOURCES IN LATIN AMERICA (COLOMBIA)

Centro Interamericano

Translation of "Estudio y propuestas sobre programas de sensores remotos para la evaluación y manejo de recursos en America Latina, (Colombia), (Paper presented at the United Nations' Regional Seminar on Space Applications organized in preparation for the Second United Nations' Conference on the Exploration and Utilization of Outer Space for Peaceful Purposes, Quito, Ecuador, 19-23 April 1982), (UNISPACE 82), Bogota, Colombia, 1982, pp 1-27



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14. Abstract A report is given on the situation in regard to diagnostic studies carried out on the use of remote sensing techniques at the regional level, and discussions held at international meetings on this topic. Studies and proposals presented by different organizations are discussed. It is concluded that a consultative body must be established at the regional level.			
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STUDIES AND PROPOSALS ON REMOTE SENSING
PROGRAMS FOR THE EVALUATION AND MANAGEMENT
OF RESOURCES IN LATIN AMERICA (COLOMBIA)

1. INTRODUCTION

Ever since the beginning of the exploration of outer /2*
space, the scientists throughout the world saw in this new
technology a very useful tool in the search for solutions for
many of the problems of the Third World. Most of these prob-
lems are due to the lack of knowledge about natural resources
and finally their adequate use for the benefit of the nations.

Some attempts have been made to establish programs which
provide a solution to the problems of the region, facilitating
the technological exchange in the use and application of remote
sensors for the evaluation and management of the natural resources,
but most of these programs are held up chiefly for want of a
Latin-American consultative organization.

This paper will give a report on the situation in regard to
the diagnostic studies carried out on the use of the remote sen-
sing techniques at the regional level, the discussions held at
international meetings on the same topic, and the participation
of the international organizations in the application of the sol-
utions to the detected problems.

There is great similarity between the conclusions obtained in
the different studies and meetings with regard to the problems
and prospects of the region and the possible solutions. Never-
theless, very few of the recommendations have been implemented.
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*Numbers in margin indicate foreign pagination.

the different studies and meetings with regard to the problems and prospects of the region and the possible solutions. Nevertheless, very few of the recommendations have been implemented. There are some critical points or "bottlenecks" which are indispensable to overcome to create a real regional awareness which would allow a step forward to the solution of the essential needs of the region, such as, suitable data, increase in the programs of technology transfer, and the coordination of programs at a regional level.

2. STUDIES AND PROPOSALS PRESENTED BY DIFFERENT ORGANIZATIONS

2.1 Diagnostic Studies.

2.1.1 Remote sensing as a Prospect for Developing Countries.

The National Academy of Sciences of the United States published in 1977 an extensive study on prospecting for resources from space. In this study, formulations are made on information bases taking into account particularly the technical aspects and prospects of the system of remote sensing from outer space, and the prospects for the immediate future.

The study lays emphasis on the experience obtained on the basis of the Landsat programs 1 and 2, besides an analysis of the activities of remote sensing of the Third World countries. Finally it establishes the bases for programs of assistance in remote sensing, analyzing the possibilities of the U.S. institutions such as AID, NASA and USGS.

2.1.2 Report of the Present Situation (1979) of the Countries of Latin America and the Caribbean in the Use of Remote Sensors

This study was carried out by the Interamerican Institute of Agricultural Sciences, the IICA, whose basic object was to achieve a serious and concise prediction of the present and future activities of each country of Latin America and the Caribbean in the area of remote sensors. Special commissions were

established which visited: the Paraguay, Chile, Argentina, Panama, Bolivia, Columbia, Peru, Venezuela, Ecuador, Costa Rica, El Salvador, Honduras, Guatemala, Mexico, Haiti, the Dominican Republic and Jamaica. They also analyzed through reports and regional agencies, even without visiting them: Barbados, Uruguay, Nicaragua and Brazil.

As a result of this analysis, a program was proposed for the regional rural development, based on the study and evaluation of natural resources by means of remote sensors. The following problems were identified as common to the countries in the area of use of remote sensors:

- Want of duly qualified human resources
- Unplanned training of some human resources
- Real lack of knowledge of the use and limitations of technology (present, future and research techniques).
- Want of research applied to the real problems of the Latin American countries
- Want of basic infrastructure (equipment and plants)
- Want of mechanisms for the exchange of information between the organizations producing the information, the latter, the user, and the user organizations themselves.
- Want of a system of institutional, national and regional coordination in the use of remote sensors.
- Want of literature in Spanish on remote sensors, and finally
- Want of planning and definite policies in the management of natural resources.

2.1.3 Predictions on the Development of Remote Sensing in Latin America Obtained at International Meetings

2.3.1 Second International Seminar on Remote Sensors in Decision Making (Bogota, Colombia, January 1979)

The object of this seminar was to furnish to the legislators, and their main technical advisers, a clear idea of the impact which

remote sensor techniques have in the formulation of policies.

The delegates agreed in the conclusion that the remote sensing techniques are useful in multidisciplinary and multisector surveys and in the monitoring of processes and developments. The combination of nonconventional techniques with the conventional interpretation proved to be particularly useful.

The following was recommended:

That the governments of the Latin American countries should establish the Latin American Council of Remote Sensors for the purpose of formulating the Latin American programs and policies related to regional remote sensing.

That Latin American training centers should be established, which would accomplish at the same time functions of consultation and circulation of information with regard to remote sensors; reinforce the existing capability and develop it towards training centers for remote sensors, with financial and technical aid of international organizations such as the International Bank for Development, the United Nations Center for Remote Sensing, the FAO, PNUD, UNEP, UNESCO, OEA, CEPAL and other such organizations.

Spreading of the knowledge and training in remote sensors at university levels, secondary school, technical education and specialized institutes.

Complete refresher and updating courses for specialists working in the applications of remote sensors.

Intensify research for the better use of remote sensors in the socio-economic areas.

Increasing the awareness of officers in charge of planning and decision making of the potential represented by the remote sensors.

Analyzing the cost/profit factors in the projects of remote sensors, taking into consideration the additional benefit repre-

sented in the multiple use of the same data for other purposes.

Use more adequately the existing sources of data by improving their accessibility.

Be alert to the rapid technological development especially with regard to data management.

2.1.3.2 XIV International Symposium on Remote Sensing of the Environment. Applications of Remote Sensing in Latin America (San Jose, Costa Rica, April 1980, Luis Bartolucci)

Latin America and the Caribbean region constitute one of the most vast and most diversified regions in the world: the large stretches of the Amazonian forest, the Andes range of mountains, the vast savannas of the Pampas, the deserts of Chile and Mexico /6 the warm coasts of the Caribbean, and the almost permanently frozen regions of the Tierra de Fuego represent the greatest variety of environment in the world.

This complexity of environments with the extremely dense population (400 million persons) creates serious difficulties in the manner in which the natural resources should be used: the greatest present need in this area is to obtain basic data for charting and monitoring these resources. Initially we have to carry out a systematic survey and delimitation of unused and underused natural resources such as: woods, savannahs, soils, mineral deposits, fisheries, etc. Subsequently, the remote sensors are used to monitor the development of the resources and protect them from over-use and random destruction.

The different environments and resources require different types of data. The conclusion is drawn that remote sensing may be considered as an essential tool, but not as a panacea for the harmonious development of the extensive and rich Latin American resources.

2.1.3.4 First Meeting of Latin American Professional Specialists in Remote Sensing (Quito, Ecuador, November 1980)

This meeting taking into account the presentations of different experts, summed up as follows the main aspects of remote sensing in Latin America:

It urges the need for obtaining LANDSAT pictures in an operational form in the Latin American countries. At the present time, not all are covered by the existing antennas.

Remote sensing data banks and other types of data must be established to facilitate the user's services.

Training is needed for the digital processing of pictures.

There is want of interinstitutional and inter-American technical cooperation.

Interest must be shown at the level of decision making organizations for implementing remote sensing programs.

The exchange of technical and scientific documents must be encouraged.

It seems necessary to centralize the remote sensing activities in countries, especially with regard to data banks and highly specialized equipment.

Local associations must be established to strengthen the Latin American Association.

It was found necessary to carry out applied investigations showing the ranges and limitations of the remote sensors.

There are regional centers of remote sensing located in different Latin American countries of acknowledged prestige, some of them with very well defined programs, such as, for example, the CIAF in Colombia. Finally

In some countries, there is no course on remote sensing at the university level.

Recommendations:

It is recommended to the participants of each nation to promote national meetings for the purpose of:

- Present updated information on remote sensing and its applications in Geology, Geomorphology, Soils, Agriculture, /8 Forest Science, Geography, Climatology, Meteorology, Hydrology, Engineering, Photogrammetry, Planning and Integrated Regional Surveys.
- Present the possibilities of use of remote sensors in the prediction and study of dynamic processes and monitoring of the natural resources and the environment.
- Analyze the present situation as regards knowledge and potential of remote sensing techniques for natural resources.
- Define selection criteria of systems of remote sensors for specific purposes.
- Analyze the present level of teaching and research in the area of remote sensors.
- Study the existing capacities in the various national organizations to reduce to a minimum the time, efforts and cost of research and application.
- Discuss the need for creating data banks and systems for the exchange of information obtained from remote sensing and from other sources.

It is recommended that the members of the Association should suggest to their Governments that all the studies and investigations using remote sensing should consider the preservation of the ecological balances within the balance between man and nature, as a basic declaration in the exploration, use and application of natural resources.

It is recommended that it is indispensable to establish a third station to receive and process satellite data to /9 complete the coverage of data in Latin America, for which we must analyze the possibility of converting the tracking station in Quito into a receiving and processing station.

It is recommended that the technicians of the countries belonging to the Association impress upon their respective governments the need for implementing and reinforcing their training programs for remote sensing.

2.1.3.4 Regional Latin American Meeting of Users of Remote Sensors (INPE Sao Jose dos Santos Brazil, December, 1981).

In this meeting of users of remote sensors, three working groups were established assigned to the analysis of the following topics:

Group A Data distribution

Group B Applications of Remote Sensing by Satellite.

Group C Latin American Cooperation

The main conclusions and recommendations are as follows:

Data Distribution

The data receiving centers agree to distribute material to all the potential users in the region.

It was agreed to establish catalogs on the availability of Landsat data for Latin America in its stations to simplify access of regional users.

The processing centers will have to work in coordination to establish a consistent price policy.

These centers agree to hold meetings on the advances in remote sensing. The working groups on satellite programs will hold these meetings for the purpose of adopting a regional policy on common topics.

The countries which are not covered by the existing ground stations or those planned must attempt to establish at least one

station of low cost permitting direct access to recording of high density belts which can be processed in other stations. This is a possible solution to the needs for obtaining data, since the problems of recording on board satellites will not be solved on the short term level.

Application of Remote Sensing Via Satellite.

An analysis was conducted of the needs for future systems from the technical point of view: spectral bands, spatial resolution, repetition cycle, geographic coverage, speed and security of delivery, volume of data, data format, possibility of stereoscopy. These parameters were analyzed in relation to different disciplines such as: Agriculture, Geology, Forestry, Marine Resources, Geothermal Resources, Hydric Resources, Environmental Pollution, Meteorology, Cartography, Inventory of Natural and Mineral Resources.

- Exchanges between the users and space agencies are recommended for designing new systems in accordance with the requirements of the countries. /11

Latin American Cooperation

It was proposed to constitute a working committee consisting of the representatives of Argentina and Brazil as owners of antennas and Chile and Colombia on the part of the users for the purpose of:

- Conducting within a short period a census of the Latin-American institutions involved in the use of remote sensing.
- Establish on a medium term basis contact with these institutions, informing them about the objectives of this committee, and supplying them with data on the future remote sensing satellites.

Within a period of time to be established for countries which do not have institutions specialized in remote sensing or who have

more than one institution in this area, an official consultation will be made to indicate the organization which will represent the country in a Latin-American Council of Remote Sensors already recommended in previous meetings. The objectives of the council will be:

- Establish joint programs of remote sensors and technology transfer.
- Propose mechanisms to increase the use of remote sensing in Latin America.

2.2 Proposals and Programs of Cooperation

The cooperation received from international organizations was channeled to programs of national order.

2.2.1 Financing of Programs by International Agencies

2.2.1.1 United Nations

Within the Program of the Division of Outer Space of the United Nations, meetings were organized in which they discussed the use and problems of the applications of remote sensing to the solution of the problems of the needs in the developing countries.

In this connection, the organization and financing of the preparatory meetings for UNISPACE 82, including those held in Buenos Aires in April 1981 and this seminar, dedicated specifically to establishing bases for Latin America for a sure participation in the description of the policies on the peaceful uses of outer space (the final goal of Unispace 82) are particularly valuable.

UNESCO contributed to remote sensing techniques by financing scholarships in the developing countries, so that professional persons may take part in courses on the application of this technology to the study and management of their resources.

The FAO programs in Latin America are related greatly to the aid to the different countries in the improvement of the techniques and methods of agricultural production. With regard to the use of remote sensing, one of its aspects refers to transfer of technology by courses on the interpretation of small scale photos and other pictures from remote sensors.

2.2.1.2 Inter-American Bank of Development, BID

The primary purpose of the Inter-American Bank for Development was to finance plans for development in Latin America. In the area of remote sensing, the bank is concentrating its efforts on:

- The applications of remote sensing in data collection in a suitable form, thus deriving reliable data on natural resources.
- The multidisciplinary uses of technology in the execution of decisions on investments for the development of projects of member countries.
- Training of personnel, acquisition of programs and equipment and adequate technology transfer to satisfy specific needs for the development of Latin American countries.

As a result of this financing policy, the BID lent nearly 15 million dollars in 1972-1981 for remote sensing programs. The beneficiaries of these loans were among others Bolivia, Brazil, Ecuador, Venezuela and Central America.

2.2.1.3 Feasibility Studies for the Establishment of a Center of Remote Sensing in Latin America. Conducted by AID (1979)

With the experience acquired by the creation of three centers for remote sensing established in Nairobi, Ouagadougou and Bangkok, the International Agency for Development (AID) decided to study the feasibility of creating a similar center in Latin America. The objectives of this study were:

- To define the need for installing one or more centers in Latin America. /14
- Type of center to be established.
- The interest of the countries in the region to cooperate technically and financially in its establishment.

Several specialists visited the Latin American countries with possibilities for the installation of this center and handed over to the AID the corresponding report with conclusions and recommendations.

2.2.2 Technology Transfer

Scientific research is very costly and requires highly qualified personnel, elements which are found with difficulty in developing countries. Therefore, it is necessary that the countries which have limitations in this area should resort to the experience of those who have the means of investigation and also experience.

The training of technical personnel at the intermediate level does not require pure scientific research, but applied research. That is why Latin America was able to find a solution to this type of training. Formal education at a high level continues to be given mainly by countries with a high development index.

2.2.2.1 Training and Education at a Regional Level

Several institutions accomplish the work of training technological personnel in the analysis of data obtained by remote sensing systems among which the following may be mentioned:

2.2.2.1.1 Interamerican Center of Photointerpretation (CIAF) of Colombia.

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Since it was founded in 1967, the Interamerican Center of Photointerpretation, CIAF trained more than 600 professionals from 21 Latin American countries. This training was given in the

areas of forestry engineering and ecology, civil engineering, geology and morphology, soils and agriculture and regional surveys, in annual courses each lasting 40 weeks. Furthermore more than 1,500 Colombian and foreign technicians and professionals took part in short courses.

In the immediate future (1983), the CIAF will have modern equipment for digital processing of data with which courses can be offered at a more advanced technical level and in accordance with modern technology. These courses will be of great benefit for Latin American professionals, since they will be given in Spanish.

2.2.2.1.2 School of Cartography, Interamerican Geodesy Service (IAGS) of Panama

The Cartography School was established by the IAGS in 1952 to provide instruction and training in Spanish in the areas of cartography, geodesy, geophysics and photogrammetry. In the last years of the School, new informative courses were introduced on principles of remote sensing and their applications.

2.2.2.1.3 National Space Research Commission (CNIE) of Argentina

The Commission operates its own receiving station and is responsible for processing and distributing Landsat data. It organizes and manages its own seminars, workshops and courses /16 on remote sensing in collaboration with national educational organizations and institutions and with the support of international organizations.

2.2.2.2 Training and Education at the World Level

The Latin American countries may benefit by the advanced courses as well as the informative and medium level ones offered at the international level.

The EROS Data Center in the United States regularly programs training courses and workshops. Likewise other United States

institutions such as the U.S. Geological Survey offer regularly short courses in which technicians from anywhere in the world may take part.

In 1975 at least 470 courses were held in the United States and 64 in Canada in which emphasis was laid on remote sensing and photogrammetry. Many of these courses lead to higher qualifications with applications to ground sciences.

The International Institute of Aerial Surveys and Earth Sciences (ITC) of Holland offers courses for technicians and professional people on the interpretation of pictures applied to sciences of the Earth.

At this point there is an urgent need for training technicians at a higher level to establish groups of scientists who will act as leaders and teachers in their respective countries. In this connection, the opportunities offered by some universities in the United States, Canada and Europe in which higher studies may be pursued to the level of Master's degree or doctorate are particularly important.

2.2.3 Existing Infrastructure

In the case of Latin America, South America is covered by the satellite data-receiving antennas located in Brazil and Argentina. The north of Colombia, part of Ecuador, Peru and Venezuela as well as Central America, part of the Caribbean and the south of Mexico, is not covered by the existing antennas (see Fig. No. 1).

In addition, the technical problems occurring in the LANDSAT 3 recording systems leave an extensive portion of the region without information until the LANDSAT D is launched. This situation may cause difficulty, especially in the development of programs based on the use of satellite data in these countries.

The importance of obtaining data-receiving antennas becomes more apparent when analyzing the coverage achieved with the 11 antennas installed up to now. Only the central part of Africa and the sub-region consisting of Central America, the Caribbean (part) and the north of South America are not covered by these stations.

The countries owning data-receiving antennas in Latin America (Brazil and Argentina) provide an efficient service of data processing and distribution to the countries covered by their receiving antennas. These countries are also those best equipped to analyze the data using digital processing.

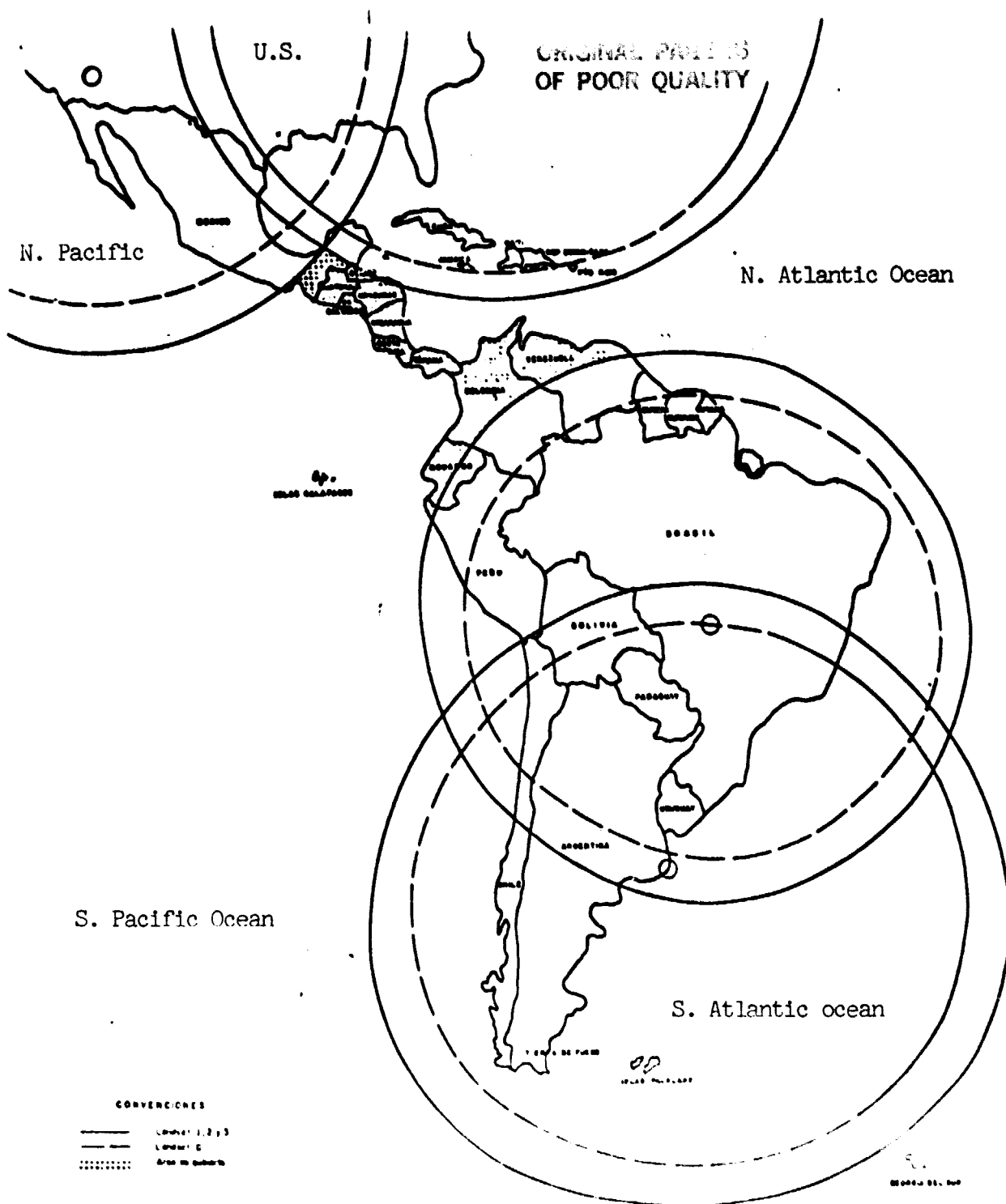


Fig. 1 Coverage of the receiving stations of LANDSAT data in Latin America and the Caribbean.

Most of the training at the regional level was accomplished through the visual interpretation of the pictures, in courses /18 offered by the Interamerican Center of Photointerpretation. The existing methods for this type of analysis have given so far efficient service. With a view to updating its training programs, the CIAF is now acquiring equipment for the digital processing of data, as was stated in 2.2.2.1.1.

The Interamerican Bank for Development as a regional financial organization considers that strengthening the programs of remote sensing in Latin America is an important aspect, and the financing of highly technical equipment is an essential element in this strengthening.

2.3 Regional Associations

An effective form of technology transfer is the formation of associations whose purpose is to promote and spread exchanges between technicians with kindred interests.

At the regional level, the Association of Latin American Specialists in Remote Sensing, SELPER, has been entrusted with beginning the implementation of this need for forming an association. Keeping in mind the short time since its foundation, it is important to stress the fact that the Association has accomplished its objectives by spreading the technology as is shown by the proceedings of the Second Meeting of SELPER and the Seminar on the SPOT Satellite and Its Application in Natural Resources. To achieve its objectives, this association needs the support of other national associations and international organizations.

Many Latin American technicians have become affiliated with the International Association of Remote Sensors and the American Association of Photogrammetry, to take part in the benefits of these organizations, especially with regard to technological exchange.

Since January 1979 (Second International Seminar on Remote Sensing in Decision Making), the creation of the Latin American Council of Remote Sensors has been recommended. During this event, a document was prepared with detailed information for the organization and operation of the Council (Brockmann, 1979). The above-mentioned document establishes the structural organization, gives considerations on financing, objectives, member countries and associates, duties and obligations of the member countries, integrating organs and their functions. Nevertheless, this planning was only an idea with a hearty acceptance at all regional meetings, but which continues only with hopes of implementation. /19

3. Present Situation of the Studies and Proposals

The diagnostic studies carried out by the IICA and the National Academy of Sciences of the United States detected a large number of problems which mostly remain latent. The proposal of the Interamerican Institute of Agricultural Sciences for the establishment of a regional program was recommended at the level of the Ministries of Agriculture of the member countries, but this program has not yet been implemented.

The meetings of experts at the international level have laid emphasis on the need for the creation of the Latin American Council of Remote Sensors as a consultative organization at the regional level. It has at present only the ad-hoc working group with representatives of Argentina, Brazil, Colombia, established in the Seminar on the Users of Remote Sensors held in Brazil (1981), whose mission is to start the basic consultation for the integration of the Council.

The financing proposals by the international organizations continue to be in force, provided that the countries concerned present programs complying with the requirements imposed and

adjust to the aid policies established by the different organizations.

/20

The transfer of technology was rather functional at the regional level. The large volume of training of technical personnel was concentrated at the intermediate level, and the post graduate level to train specialists in visual interpretation with theoretical bases of the digital processing of pictures.

Higher education is still poor in our country. The scarcity of centers providing a formal education to the level of Master's degree or doctorate in Spanish was a difficult barrier to overcome in this respect. To this factor we may add also the difficulty of obtaining financing to pursue higher studies in North American and/or European universities.

UNISPACE 82

An especially important contribution was given by the Commission on Education and Training in the Applications of Remote Sensing, within the Preparatory Commission for the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82). This commission accomplished a complete analysis for the purpose of providing the member countries of the Organization the information which would permit them to define their requirements and identify the national and international policies on education and training for the application of remote sensing data obtained by satellite.

On the basis of the studies and assumptions made by the group and according to the evaluation of the requirements of education and training, the developing countries whose population is of the order of 3,000 million persons will have a demand for educational training related to the applications of remote sensors of approximately 18,000 man-years during the decade 1980-1990. The pre-

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sent capacity for these countries is approximately one tenth of this amount. It is therefore of primordial interest to introduce new educational methods aimed at reaching a large number of persons at the same time.

The existing infrastructure is insufficient under all aspects to satisfy the needs of the region. The countries which are not covered by the LANDSAT data-receiving stations of Brazil and Argentina are fully aware of the need of setting up an antenna and data processing center which would fulfil the needs of those countries. At present, the most concrete proposal in this direction was put forward by Ecuador, a country which offered to change the tracking station in Cotopaxi into a receiving station and a processing center. If this proposal is accepted by the countries concerned, a solution would be attained at a relatively low cost and within a short time.

4. ANALYSIS OF THE SITUATION

4.1 Diagnostic Studies

The problems of use of remote sensing systems to know the resources have been broadly analyzed both in extensive studies like those conducted by the Interamerican Institute of Agriculture and the National Academy of Sciences of the United States, and the studies presented at international meetings and discussions arising at meetings of this nature. It is obvious that there is enough information on this topic; therefore hereafter all efforts must be made to implement the plans and programs recommended. For the moment, there is no justification in devoting efforts to detect the existing problems, but rather for solving them on the basis of the many recommendations offered in the /22 diagnostic studies.

The following may be considered the main causes for the non-implementation of the conclusions and recommendations of the diagnostic studies:

- Want of information and interest in the higher authorities in charge of establishing policies in programs of national range.
- The lack of timely recourse to sources of external financing, especially because of what was stated in the previous item.
- Most of the countries lack their own resources to implement programs on a national or regional level and finally
- No national organizations with sufficient operational capacities have been established.

4.2 International Cooperation

There are sufficient sources of financing to promote programs and projects on the use of remote sensing in Latin-American countries; however, only few countries benefit by these sources of financing. The main reasons for this situation are:

- Want of motivation by the authorities empowered to make decisions.

In most cases, these officials are politicians or experts in administrative areas; therefore they are not fully aware of the possibilities of this new technology. The technicians must provide the leaders with sufficient explanations to provide motivation, and thus achieve the approval of the higher governmental spheres for the presentation of programs of national and regional range. /23

- The want of a coordinating organization for programs at a regional level.

The creation of the Latin American Council of Remote Sensors is urgently needed since at the present time there is no organization in charge of formulating and coordinating projects of

the countries involved.

- Insufficiency of high qualifications and dissemination of the knowledge acquired.

To formulate high level programs and projects, each country must have a sufficient group of highly qualified technicians, knowing the technology and its applicability to the solution of national and regional problems. This same inadequacy of training is the reason why the high executives do not receive for their study programs which are impressive and provide positive motivation.

A phenomenon occurring commonly in our countries is the fact that there are in them technicians of very high qualification, but no programs of circulation have been established so that the knowledge acquired by this select group be imparted to other professional people. It is imperative that the countries of the region should pass as soon as possible from the phase of information to that of the practical application of the knowledge.

- Pilot projects are needed to prove the suitability and applicability of these remote sensing systems.

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The technicians are aware of what is needed to solve the problems for developing countries; but the higher officials and the general public must be convinced of the possibilities of this technology and the best way to achieve this is to present positive results which should attract their attention and approval.

Special Cases

Special situations often occur which impede over long periods the implementation of development programs. This is the case of difficult political situations such as occur nowadays in some Central American countries, situations absorbing totally the attention and economic capacities of the country, preventing them from becoming involved in any activity which does not concern the

solution of its imminent problems.

4.3 Prospects of Technology Transfer

Technology transfer both at the regional and international level has been functional so far. From the report of the Commission on Education and Training for UNISPACE 82, it may be deduced that it is urgently necessary to increase the training programs at all levels.

The regional institutes such as the CIAF require greater support from institutions for regional cooperation, since up to now these institutions have dedicated all their efforts to the financing of their own appointed institutions, but not to the others.

5. Conclusions

/25

A consultative body must be established at the regional level. In order not to continue the trend of the previous meetings, the United Nations must recommend to the member countries that they establish the Latin American Council on Remote Sensors.

It may be stated that there is sufficient information on the need for the acquisition of LANDSAT data for the north of South America and Central America, and that is why there is urgent need to start suitable action for the acquisition of a data-receiving center.

Ever since 1972 when NASA launched the first satellite to study natural resources, engineers have been interested in obtaining information presented in documents and meetings at the international level. But the application of the knowledge acquired has not been implemented at a desirable rate. It is recommended that projects be implemented which would make it possible to prove the suitability of these systems for solving specific problems.

Evaluations were made of the natural resources in the Amazon Basin. It is time to implement a joint program for using these

resources and periodical monitoring to obtain an effective relation of this area to the economy of the region, without causing the destruction of such important ecological reserves.

In some countries, there is an imbalance between technical qualifications and the infrastructure - either because there is proper equipment, but few technicians or else there are enough technicians but there is want of adequate equipment. The /26 planning of regional projects might make a considerable contribution to the solution of this type of imbalance.

There is a need for diversifying the sources of information. The programs such as SPOT, MAPSAT, SHUTTLE, etc., will produce highly technical data, with which we will certainly be able to supplement the results obtained with the LANDSAT program.

The regional plans of study of natural resources will have to focus on the use of the present and future innovations, both with regard to the analysis and acquisition of data.

In view of the great extent of the territory covered by Latin America and the Caribbean and the complexity of the region in which all the climates, relief and ecological media may be found, we might think of a subregionalization to associate the areas with some similarity and with kindred interests: one possibility would be to establish four sub-regions:

1. Mexico, Central America, Caribbean and the north of South-America
2. Countries of the Andean region
3. Brazil
4. South Cone

These subregions could have appointed committees with the Latin American Council of Remote Sensors to integrate their own programs with those of common interest in the region.

In different international meetings, the situation of remote sensing in Latin America has been discussed and invariably the

conclusion was reached that expresses in some form or the other the same idea, such as: formulation of policies on the use of remote sensors, need for forming associations, presentation of working projects to national and international organizations, etc. Since the situation continues to be the same, the conclusions presented in this paper cannot differ substantially from this repetitive mold. /27

But it is worth stressing the need for taking a step forward: To go beyond the state of diagnosis of the problem and come to an action favoring the solution of problems discussed so often.

The greatest fruit which could be obtained from this meeting would be the possibility of establishing immediately a plan of action, tending not toward an analysis of the regional situation in the area of remote sensing, but a solution of the many problems which have already been detected.

Meetings on this topic are held periodically. It is recommended to take all the necessary measures to reduce to the minimum costs and efforts with meetings dealing with specific aspects and which are not repetitive and contribute in this form to the solution of our problems.

Finally by analyzing the different documents, we arrive at the conclusion that in Latin America there are centers which have accomplished a considerable work of dissemination and transfer of technology. Thus it is not considered suitable to establish new agencies, but to reinforce the existing centers, which should receive the support from organizations interested in the improvement of the socio-economic conditions of the Latin-American countries.